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# *Gerritea*, a New Genus of Paniceae (Poaceae: Panicoideae) from South America

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**ABSTRACT.** *Gerritea pseudopetiolata* of the tribe Paniceae is described and illustrated. Leaf anatomy of this new genus is also included, and relationships with related genera within the Paniceae are discussed.

During fieldwork carried out by T. Killeen in 1987, a previously unknown grass was collected at mid elevation in Bolivia, Department La Paz, between Coroico and Caranavi. Additionally, new specimens, previously collected by S. Beck, were found in the herbarium of LPB.

***Gerritea pseudopetiolata*** Zuloaga, Morrone & Killeen, gen. et sp. nov. TYPE: Bolivia. La Paz: Nor Yungas on road between Caranavi and Coroico, 16°00'S, 67°30'W, 800 m, 25 July 1987, T. Killeen 2632 (holotype, ISC; isotypes, F, LPB). Figures 1, 2.

Gramen perenne, caespitosum; culmis supra nodis profuse ramificantibus, 60–120 cm longis; nodis pilosis. Foliorum vaginae pilosae vel glabrae, 4–17 cm longae. Ligula inferne membranacea, superne ciliata, 0.3–0.6 mm longa. Lamina lineari-lanceolata, 11–27 cm longa, 0.7–1.5 cm lata, decidua; pseudopetiole usque 2 cm longo, piloso. Inflorescentiae paniculatae, laxae, diffusae, 14–30 cm longae, 4–12 cm latae. Spiculae ellipsoideae, 1.8–2.2 mm longae, 0.5 mm latae, longe pilosae; quam gluma infera  $\frac{3}{4}$ – $\frac{1}{2}$  longitudino spiculae aequans, pilosa, 3-nervia; gluma supera 3-nervia. Anthoecia infera neuter: lemma infera 3-nervia; palea infera 0.7–1 mm longa. Anthoecia supera bisexualia, ellipsoidea, 1.3–1.5 mm longa, 0.4 mm lata, membranacea, decidua, glabra; lemma 3-nervia, palea 2-nervia. Lodiculae 2, conduplicatae, glabrae. Stamina 3.

Caespitose perennial. Culms rigid, many noded, procumbent, 60–120 cm long, profusely branching at the upper nodes, internodes 4–9 cm long, finely striate, cylindrical, pale or tinged with purple, densely pilose toward the distal portion with whitish, appressed hairs; nodes pilose, covered with whitish, long hairs. Leaves mostly cauline. Sheaths longer than the internodes, 4–17 cm long, greenish or

tinged with purple, strongly keeled, glabrous or densely papillose-pilose, the margins membranous, ciliate; lower sheaths usually lacinate; auricles small, pilose. Ligules 0.3–0.6 mm long, membranous-ciliate, pilose on the abaxial surface, glabrous on the adaxial surface; collar pilose or glabrous, well defined with a transverse brownish line. Blades linear-lanceolate, 11–27 cm long, 0.7–1.5 cm wide, flat, with a long pseudopetiole up to 2 cm long, articulated at the base and early deciduous, sparsely pilose, the margins scaberulous, the lower ones ciliate with long whitish hairs or glabrous. Peduncle terete, up to 10 cm long, hirsute. Inflorescence a terminal, exserted, panicle, lax, pyramidal, multiflowered, 14–30 cm long, 4–12 cm wide; main axis flexuous, hispid, greenish or tinged with purple; pulvini pilose, first-order branches divergent; axis of the branches scabrous, sparsely hispid; pedicels up to 8 mm long, flexuous, scaberulous, sparsely pilose, terete. Spikelets solitary, ellipsoid, 1.8–2.2 mm long, 0.5 mm wide, slightly laterally compressed, gaping, greenish or tinged with purple, hispid; upper glume and lower lemma subequal, 3-nerved. Lower glume lanceolate, 1.4–1.9 mm long,  $\frac{3}{4}$  to  $\frac{1}{2}$  the length of the spikelet, with papillose-pilose hairs up to 7 mm long toward the margins, acuminate, 3-nerved, with a stipe 0.2 mm long below its insertion. Upper glume 1.8–2 mm long, herbaceous, acute, papillose-pilose toward the margins with whitish hairs up to 7 mm long. Lower lemma 1.6–1.7 mm long, glumiform, acute, glabrous. Lower palea ovate-lanceolate, 0.7–1 mm long, 0.1–0.2 mm wide, membranous, hyaline, the margins scaberulous, 2-nerved; lower flower absent. Upper antheridium narrowly ellipsoid, 1.3–1.5 mm long, 0.4 mm wide, glabrous, membranous, smooth, pale, disarticulating at maturity; lemma 3-nerved, the margins flat, not enrolled over the palea; palea 2-nerved, free at its apex; lodicules 2, conduplicate, truncate, 0.2 mm long, embracing the lower margins of the palea; stamens 3, anthers 0.6–0.7 mm long; styles 2, free; stigmas plumose, whitish. Caryopsis not seen.



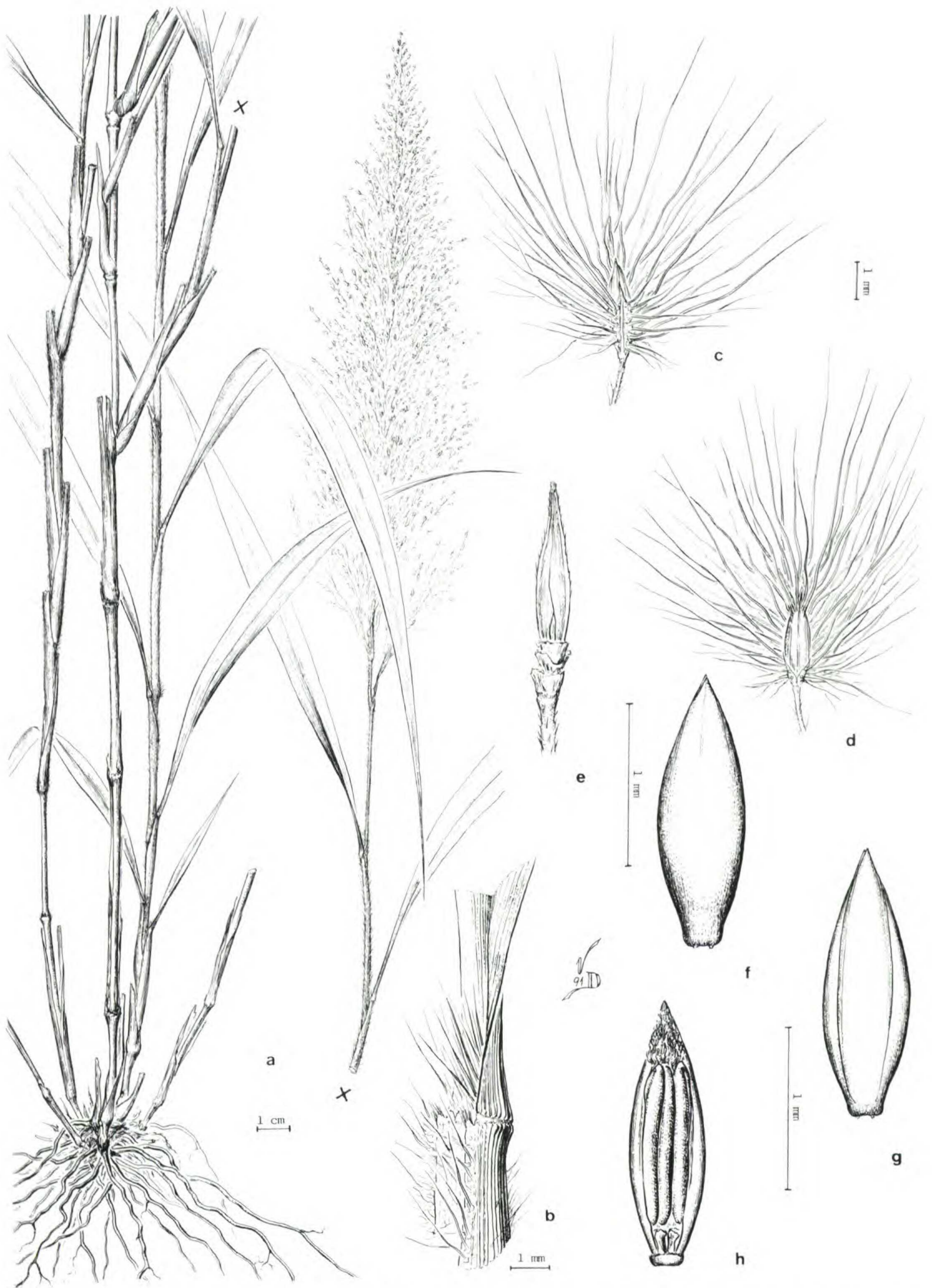


Figure 1. *Gerritea pseudopetiolata* Zuloaga, Morrone & Killeen. —a. Habit, with inflorescence included. —b. Detail of ligule and lower portion of the blade. —c. Spikelet, lower glume view. —d. Spikelet, upper glume view. —e. Lower palea. —f. Upper antherium, lemma view. —g. Upper antherium, palea view. —h. Upper palea with lodicules, stamens, and portion of stigmas. Based on Killeen 2632.



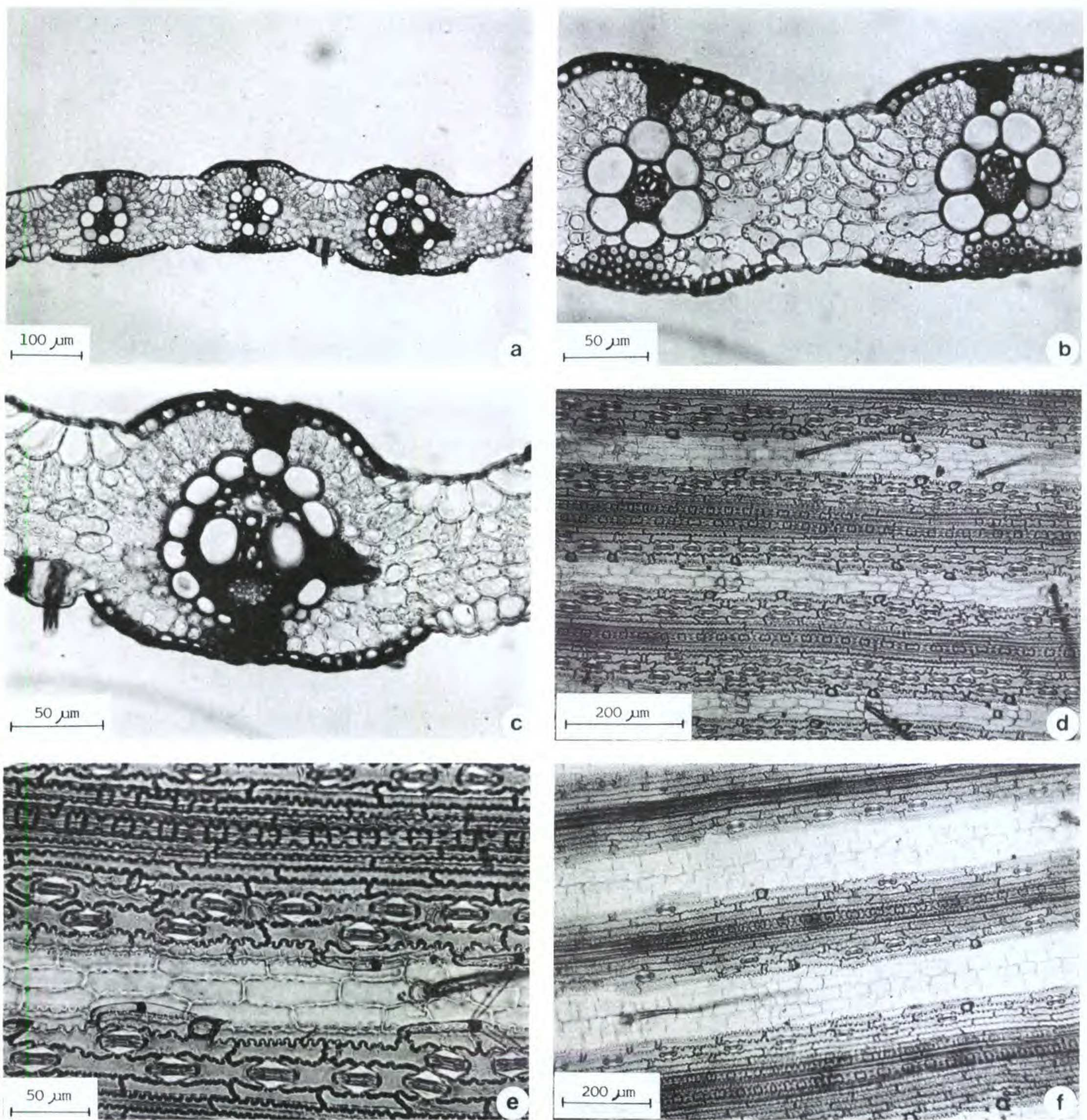


Figure 2. Leaf blade anatomy of *Gerritea pseudopetiolata*. a-c, Transverse anatomy. —a. Transverse section detail showing first- and second-order vascular bundles. —b. Detail showing second-order vascular bundles, bulliform cells, mesophyll cells, and sclerenchyma girders. —c. Detail showing a first-order vascular bundle. —d, e. Abaxial epidermis. —f. Adaxial epidermis. Based on Killeen 2632.

#### DISTRIBUTION AND ECOLOGY

The species has been collected only from a single locality in the “yungas” of La Paz, Bolivia. The type locality is situated on the major highway between the departments of La Paz and the Beni. This area is a small, narrow canyon about 200 m long that is a minor tributary of the Río Coroico. The canyon is notable because of a 40-m waterfall that is located at its upper edge. The vegetation of the area is a semideciduous montane forest; unfortunately, most of the original vegetation has been

destroyed due to colonization activities over the past 50 years. This particular site remains relatively unaltered due to very steep slopes that are unsuitable for agriculture.

Plants of *Gerritea pseudopetiolata* are restricted to a relatively narrow band between the road and the waterfall. The microhabitat is moist and well-shaded when compared to the surrounding forest vegetation. Plants are not found in the immediate environs of the waterfall where there is a constant mist, nor do they occur in the disturbed, more open areas in the gorge below the road.



Caespitose individuals are rooted in shallow cracks between rocks or upon a superficial mat of mosses. The rocks are sedimentary slates of probable Ordovician origin; they are hard and resistant to weathering. The species is not locally abundant, and only 11 individuals were observed in 1992. The life form of the species can be described as a lithophytic grass.

Flowering is day-length dependent. The site was visited periodically between 1989 and 1992 and reproductive material was collected only between late June and early July, when days have approximately 11 hours of light. Each culm may produce up to three secondary branches, and most terminal meristems (but not all) produce inflorescences. Occasional culms have a senescent inflorescence, as well as a new inflorescence from a secondary branch produced during the subsequent year. Flowering culms may have as many as 25 internodes or as few as six.

#### BIOGEOGRAPHY

“Yungas” is a Bolivian term describing the humid intermontane valleys of the eastern slope of the Andes. In traditional natural history literature it usually refers to the valleys directly to the northeast of the city of La Paz. This area covers vegetation types ranging from humid tropical forest to semi-deciduous tropical forest, cloud forest, and tropical montane grassland (the latter probably anthropogenic). The La Paz yungas is the most extensively explored region in Bolivia and has been the focus of numerous collecting expeditions by botanists since the latter part of the 19th century (Funk & Mori, 1989). Numerous endemic species have been described for the La Paz yungas, and a total of 88 species of vascular plants are known (pers. comm., Centro de Datos para la Conservación—Bolivia); of these most are epiphytic orchids (23 species) and bromeliads (20 species). This is the first report of an endemic grass genus for Bolivia. The life form of the species is similar to the more numerous endemic orchids and bromeliads, as it is also a lithophyte.

**Paratypes.** BOLIVIA. **La Paz:** Nor Yungas, carretera La Paz–Caranavi, 27 km de Caranavi, cañón estrecho cerca de una cascada grande, laderas rocosas, 700 m, 18 June 1989, *Smith & Buddensiek 13515* (LPB, MO, SI); Caranavi, 28 km hacia Coroico, 930 m, 70°W, matorral húmedo sobre rocas, 12 Mar. 1979, *Beck 556* (LPB), 16 July 1979, *Beck 1766* (LPB).

The new genus is named after Gerrit Davidse in recognition of his work on the rich grass flora of the American tropics and his generosity in helping us with the first studies of this new genus. The

specific epithet makes reference to the conspicuous pseudopetiolate blades.

Each individual plant of *Gerritea pseudopetiolata* consisted of between 5 and 40 culms arranged in caespitose tussocks. Culms are decumbent and “hang” downward over bare exposed rock; plants do not root at the nodes, even when suitable substrate is available. Culms are long-lived and produce up to 25 internodes; only the upper 4–6 nodes support green foliage. Leaf blades are articulate below the pseudopetiole and early deciduous; the lower nodes are covered by senescent sheaths. Deciduous leaf blades in grasses have been cited by Arber (1934) in *Aristida cyanantha* Steudel ex Trinius and *Agropyron repens* P. Beauvois.

Spikelets are markedly pilose, the hairs up to four times the length of the spikelets. Davidse (1987) suggested that genera with prominent spikelet hairs are probably specialized for dispersal by adhesion and wind; among the genera Davidse mentioned are *Tricholaena* Schultes, *Rhynchelytrum* Nees, and *Leptocoryphium* Nees.

#### LEAF BLADE ANATOMY (FIGURE 2)

*Gerritea pseudopetiolata* is a non-Kranz, XyMS+ species (following the terminology described by Hattersley & Watson, 1976), characterized by having two bundle sheaths surrounding the vascular bundles, the outer parenchymatous sheath without specialized chloroplasts, and the mesophyll irregularly radiated, with 5–8 mesophyll cells between consecutive vascular bundles (Hattersley & Watson, 1975).

*Leaf in transverse section.* *Outline:* open, expanded; leaf thickness at mid-lamina 155–200  $\mu\text{m}$ , leaf thickness 130–160  $\mu\text{m}$  laterally on ribs. *Ribs and furrows:* slightly pronounced; ribs associated with all vascular bundles. *Median vascular bundle:* keel developed; median vascular bundle structurally distinguishable from lateral first-order vascular bundles, solitary or associated with 2 second-order vascular bundles. *Vascular bundle arrangement:* 5 first-order vascular bundles and 24–30 second-order vascular bundles per leaf section; 5–7 second-order vascular bundles between consecutive first-order vascular bundles; all vascular bundles situated in center of blade; 5–8 mesophyll cells between contiguous vascular bundles; with a distance of 165–250  $\mu\text{m}$  between consecutive vascular bundles. *First-order* vascular bundles round in outline; metaxylem vessel elements wide, slightly greater than parenchyma sheath cells, with angular walls; protoxylem vessel and lacunae cavity present; phloem tissue adjoining the inner bundle sheath. *Second-order* vascular bundles angular in outline with xylem and



phloem tissue distinguishable. *Vascular bundle sheaths*: outer first-order bundle sheaths consisting of 8–13 parenchyma cells, with abaxial interruption of sclerenchyma girders; outer second-order bundle sheaths completely surrounding the vascular bundles, with 6–8 parenchyma cells; bundle sheath extensions only present in second-order vascular bundles contiguous to the keel, otherwise absent; parenchyma sheath cells inflated with thin walls and lacking chloroplasts; mestome bundle sheaths completely surrounding the xylem and phloem tissue. *Sclerenchyma*: adaxial and abaxial girders associated with first- and second-order vascular bundles. *Mesophyll*: chlorenchyma irregularly radiated in two layers around the vascular bundles in the adaxial surface; adaxial cells tend to a palisadelike type of arrangement in the adaxial chlorenchyma; chlorenchyma cells tabular, raquimorphous or isodiametric, with intercellular air spaces. *Adaxial epidermal cells*: bulliform cells present in adaxial furrows between all vascular bundles, in restricted groups of 4–6 fan-shaped cells; small epidermal cells associated with the ribs; unicellular macrohairs either with raised cushion-bases or inserted between unmodified epidermal cells as seen in section. *Abaxial epidermis*: bulliform cells and macrohairs present in the abaxial furrows, similar to the ones of the adaxial epiderm cells; papillae absent.

#### ABAXIAL EPIDERMIS

*Zonation*: costal and intercostal zones distinguishable. *Costal zones*: with 4–7 files of cells. Silica bodies dumbbell-shaped, usually alternating with 1 square cork cell; prickles not observed. *Intercostal cells*: narrow, 10–15 cells wide, *long cells* rectangular in shape, more than three times as long as wide; cells adjoining the costal zones with undulated walls, central cells of the intercostal zones with sinuous walls; *short cells* solitary or paired, irregularly present; silica bodies irregular in outline or cruciform. *Stomata complex* 26–32.5  $\mu\text{m}$  long, 14–18.2  $\mu\text{m}$  wide, in 4 rows in the intercostal zones, subsidiary cells triangular-shaped. *Microhairs* fusiform, 70–98  $\mu\text{m}$  long, bicellular, with walls of the basal cell parallel, thicker than the walls of the distal cells, apex of the distal cell sharply pointed. *Hooks* small, with the bases shorter than the stomata, the barb longer than the base. *Macrohairs* unicellular, 150–315  $\mu\text{m}$  long, the epidermal cells associated with the base. *Papillae* absent.

#### ADAXIAL EPIDERMIS

*Intercostal long and short cells*: similar to the ones of the abaxial surface. *Stomata complex* in 2

rows in the intercostal zones. *Microhairs* as in the abaxial epidermis. *Hooks*: intercostal hooks irregularly present. *Macrohairs* similar to the ones of the abaxial surface. *Papillae* absent.

#### RELATIONSHIP TO OTHER GENERA OF THE PANICEAE

*Gerritea* belongs to the tribe Paniceae, which includes genera with biflowered spikelets, disarticulating below the glumes and with upper antherium more or less indurated, the glumes membranous.

*Gerritea* is distinguished from related genera by the following set of characters: pseudopetiole prominent, up to 2 cm long; blades articulated at the base and deciduous, inflorescence a lax panicle with spikelets long-pilose, laterally compressed, the lower glume  $\frac{3}{4}$  to  $\frac{1}{2}$  the length of the spikelet, 3-nerved; upper glume and lower lemma 3-nerved; lower palea small; upper antherium disarticulating from the spikelet, membranous, smooth, lemma with flat margins, the palea free toward the tip. *Gerritea* is a non-Kranz genus.

Within the tribe, *Gerritea* is related by different characters to *Panicum* L. and other genera such as *Hymenachne* P. Beauvois, *Triscenia* Grisebach, *Digitaria* Haller, *Ichnanthus* P. Beauvois, and *Tricholaena* (Clayton & Renvoize, 1986; Watson & Dallwitz, 1988; Webster et al., 1989; see Table 1).

*Hymenachne* differs by its spongy internodes, filled with aerenchyma; panicles spiciform, with primary branches appressed to the main axis, with spikelets secund; spikelets dorsiventrally compressed, with lower glume up to  $\frac{1}{2}$  the length of the spikelet, the lower palea absent.

*Triscenia* is distinguished by its filiform, non-pseudopetiolate leaves, inflorescences contracted, with racemose branches; spikelets dorsiventrally compressed, the lower glume up to  $\frac{1}{2}$  the length of the spikelet; lower palea absent, and upper antherium with the palea not free toward the apex.

*Digitaria* includes species with inflorescences with secund spikelets; spikelets plano-convex, the lower glume small or absent; upper antherium cartilaginous, the lemma with margins thinner in texture than the body. The genus comprises Kranz species.

*Ichnanthus* has inflorescences with primary branches with appressed or spreading secondary branches, with or without secund spikelets; upper antherium indurated, the lemma with involute margins and with basal scars or appendages, the palea not free toward the tip.

*Tricholaena* differs by its non-pseudopetiolate leaves, spikelets with the lower glume small, and upper antherium with the palea not free toward the tip; all species of the genus are Kranz.



TABLE 1. Comparison of *Gerritea* with related genera of the Paniceae. L: laterally compressed; D: dorsiventrally compressed; +: present; -: absent; +/-: present or absent.

	<i>Gerritea</i>	<i>Digitaria</i>	<i>Hymenachne</i>	<i>Ichnanthus</i>	<i>Panicum</i>	<i>Tricholaena</i>	<i>Triscenia</i>
Culms hollow or spongy	hollow	hollow	spongy	hollow	hollow	hollow	hollow
Pseudopetiole	+	-	-	+/-	+/-	-	-
Leaf blades filiform	-	-	-	-	+/-	-	+
Spikelet compression	L	D	D	L	D	L	D
Lower glume length/spikelet length	3/4-1/1	0-1/3	1/2	1/2-1/1	1/6-4/5	1/6	1/2
Lower palea	+	+	-	+	+/-	+	-
Upper anthercium consistency	membranous	cartilaginous	membranous	indurated	indurated/membranous	cartilaginous	membranous
Upper lemma margins	flat	flat	flat	involute	involute/flat	flat	flat
Upper anthercium wings	-	-	-	+	-	-	-
Upper palea free at apex	+	-	+	-	-	-	-
Photosynthetic type	C <sub>3</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>3</sub>	C <sub>3</sub> /C <sub>4</sub>	C <sub>3</sub>	C <sub>3</sub>



Lastly, *Panicum* has species with spikelets dorsiventrally compressed, upper antheridium indurated, the lemma with involute margins and the palea not free at the apex (the only species with upper palea free at the apex is *Panicum discrepans* Doell, which has on the other hand indurated upper antheridia). Membranous upper antheridia are only present in *Panicum* in species of section *Laxa* (A. Hitchcock & Chase) Pilger, such as *P. leptachne* Doell, *P. longum* A. Hitchcock & Chase, *P. pernambucense* (Sprengel) Pilger, and *P. grumosum* Nees (Zuloaga et al., 1992). These species have inflorescences with racemose branches, the spikelets secund, with the palea not free at the apex. *Panicum* includes Kranz and non-Kranz species.

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